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AIRCRAFT DEFOGGING AND DEFROSTING (TRANSPARENT AREA). (U)
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Provides procedures for testing and evaluating aircraft defogging and defrosting equipment. The test item may be an integral part of the aircraft environmental control system or a separate system designed to operate independently or in conjunction with the aircraft environmental control system. The procedure is to determine if the test item can prevent or eliminate fogging or frosting of the interior and exterior surfaces of aircraft transparent areas in all aircraft operational modes.		

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TOP

US ARMY TEST AND EVALUATION COMMAND
TEST OPERATIONS PROCEDURES

DRSTE-RP-702-106

*Test Operations Procedures 7-3-522

AD No.

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AIRCRAFT DEFOGGING AND DEFROSTING
(TRANSPARENT AREAS)

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1. SCOPE. This TOP covers the procedures for conducting and evaluating aircraft defogging and defrosting equipment. This equipment could be an integral part of the aircraft environmental control system or system designed to operate independently or in conjunction with the aircraft environmental control system. Both ground and airborne tests will be conducted in aircraft equipped with the developmental defogger/defroster equipment. The primary objective of this test procedure is to determine if the designated defogger/defroster equipment can prevent or eliminate fogging or frosting of the interior and exterior surfaces of designated aircraft transparencies in all aircraft operational modes and in compliance with the equipment design criteria. The performance of the defogger/defroster equipment will be evaluated against the requirements presented in the applicable approved documents, LR, LOA or ROC, and in accordance with the test design plan.

2. FACILITIES AND SUPPORT REQUIREMENTS. Developmental testing of an aircraft defogger/defroster system will be accomplished within the aircraft environment of the designated aircraft types and configurations for which

*This TOP supersedes MTP 7-3-522, 25 January 1971.

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the system was developed, and in accordance with all Army maintenance and operational scenarios established for the designated aircraft and defogger/defroster system. The facilities and support equipment required to support the developmental test should be defined in the test design plan or maintenance support plan; however, if this data is not available the following facility characteristics and support requirements should be addressed as a minimum to support the evaluation of all developmental criteria, presented in the appropriate developmental materiel documents (LR, LOA, ROC).

2.1 Facility.

<u>CHARACTERISTICS</u>	<u>MINIMUM REQUIREMENT</u>
Appropriate Operational Airfield(s)	Climatic facility (to simulate fogging and frosting conditions).
Appropriate Maintenance	Mobile shop.
Appropriate Airspace	As required to conduct tests.

2.2 Equipment and Support.

<u>CHARACTERISTICS</u>	<u>MINIMUM REQUIREMENT</u>
Installation Equipment	Standard tool set.
Photographic Equipment	Black and white camera.
Time Measuring Device	Stopwatch.
Avionics Maintenance Support	Standard unit support equipment.
Appropriate Type and Configuration Aircraft	Materiel need documents (LR, LOA, ROC).
Equipment to Measure Environmental Conditions	Thermometer, sling psychrometer.
Test Personnel	Aircraft crew(s). Data collection personnel. Maintenance and Logistics Personnel.

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CHARACTERISTICS MINIMUM REQUIREMENT

Test Personnel Equipment Applicable flight gear.

2.3 References.

- a. Army Regulation 385-16, Safety: Safety for Systems, Associated Subsystems, and Equipment.
- b. DARCOM Regulation 700-38, w/TECOM Supplement 1 and USAADTA Supplement 1, Test and Evaluation--Incidents Disclosed During Materiel Testing.
- c. TECOM Regulation 70-24, Research and Development: Documenting Test Plans and Reports.
- d. TECOM Regulation 108-1, Photographic Coverage. (As implemented by USAAVNTBD Memo 108-1).
- e. TECOM Regulation 385-6, Safety: Verification of Safety of Materiel During Testing.
- f. TECOM Regulation 700-1, Quality Assurance: Value Engineering.
- g. TECOM Regulation 750-15, Maintenance of Supplies and Equipment: Maintenance Evaluation During Testing.
- h. MIL-STD-129, Marking for Shipment and Storage.
- i. MIL-T-5842, Transparent Areas, Anti-icing, Defrosting and Defogging Systems, General Specification for.
- j. TOP 1-2-610, Human Factors Engineering.
- k. MTP 7-3-500, Physical Characteristics.
- l. TOP 7-3-501, Personnel Training.

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- m. MTP 7-3-502, Installation Characteristics.
- n. TOP 7-3-503, Arrival Inspection/Pre-Operational.
- o. MTP 7-3-506, Safety.
- p. MTP 7-3-507, Maintenance (Maintainability/Availability).
- q. MTP 7-3-508, Reliability.
- r. MTP 7-3-509, Compatibility with Related Equipment.
- s. MTP 7-3-510, Human Factors.
- t. MTP 7-3-514, Adequacy of Technical Manuals.
- u. MTP 7-3-519, Photographic Coverage.
- v. Materiel needs documents (LR, LOA, ROC).

3. PREPARATION FOR TEST. This section provides guidance for planning the developmental test. The planning phase should consummate with a detailed test plan. The test plan should establish the test methodology and provide the procedures for gathering and reducing data to accommodate each developmental test objective. The test plan should also identify all facility, equipment and support requirements including any specialized training requirements. The following test planning steps should be followed to insure a complete, thorough and cost effective developmental test.

3.1 Review. Review all pertinent data relative to the materiel development test.

- a. Materiel needs documents (LR, LOA, ROC).
- b. The test directive.
- c. Applicable material available from the developer.
- d. Pertinent reports on previous tests of like equipment.
- e. Any other applicable sources of information (AR, TOPs, TM, etc.).

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3.2 Test Objectives. The test objectives should be available in the test design plan; however, if this data is not available, review the materiel need documents for developmental criteria and consider the following sub-test objectives as a minimum.

- a. Initial Inspection - Determine the condition and completeness of the defogger/defroster equipment in accordance with TOP 7-3-503.¹
- b. Installation/Removal Characteristics - Determine the installation/removal characteristics of the defogger/defroster equipment in accordance with TOP 7-3-502.²
- c. Compatibility - Determine if the developmental defogger/defroster system is compatible with each designated aircraft for which it was designed and compatible with related equipment on intended aircraft during all phases of aircraft operation, in accordance with TOP 7-3-509.³
- d. Operational Performance - Determine the adequacy and suitability of the developmental system to prevent formation of fog or frost on transparent areas in all operational environments the designated aircraft are expected to see within their operational theater, in accordance with this TOP, paragraph 5, performance test.
- e. Reliability and Maintainability (RAM) - Evaluate the RAM characteristics of the developmental defogger/defroster equipment in compliance with TOP 7-3-507⁴ and TOP 7-3-508.⁵
- f. Technical Manuals - Determine the adequacy of the technical manuals in accordance with TOP 7-3-514.⁶

1. TOP 7-3-503, Arrival Inspection/Pre-Operational Inspection (Aviation Materiel).
2. TOP 7-3-502, Installation Characteristics (Aviation Materiel).
3. TOP 7-3-509, Aviation Materiel Compatibility with Related Equipment.
4. TOP 7-3-507, Maintenance Evaluation (Aviation Materiel).
5. TOP 7-3-508, Reliability (Aviation Materiel).
6. TOP 7-3-514, Adequacy of Technical Manuals (Aviation Materiel).

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g. Personnel Training Requirements - Determine the scope of the pre-developmental test and field training required to operate and maintain the defogger/defroster equipment, in accordance with TOP 7-3-501.

h. Human Factors - Determine if the defogger/defroster equipment meets with acceptable human factors engineering, in accordance with TOP 1-2-610.⁸

i. Safety - Identify and evaluate hazardous characteristics of the aircraft defogger/defroster system in accordance with TOP 7-3-506.⁹

3.3 Schedule. Prepare a detailed test timeline depicting each test associated event which must occur to insure availability of required support equipment, facilities, logistics and personnel to accomplish a comprehensive and cost effective test. An adequate timeline will show sufficient time periods allotted to accomplish each test objective insuring that an adequate amount of test data are taken to provide projected statistical confidences when the data is reduced. The following schedule items should be addressed as a minimum.

a. Facility. Schedule the applicable facility requirements presented in Section 2.1. Insure cold weather fogging and frosting weather conditions are adequately covered by simulated or actual weather environment.

b. Equipment and Support. Schedule the applicable equipment and support requirements presented in Section 2.2.

c. Logistics. Schedule logistics requirements including ground handling equipment, administrative transportation of both personnel and equipment, aircraft fueling and servicing accommodations.

3.4 Plan of Test¹⁰. Develop a detailed test plan in accordance with TECOM Regulation 70-24. This test plan will provide the test procedures to be

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7. TOP 7-3-501, Personnel Training (Aviation Materiel).
 8. TOP 1-2-610, Human Factors Engineering.
 9. TOP 7-3-506, Safety (Aviation Materiel).
 10. TECOM Reg 70-24, Research and Development: Documenting Test Plans and Reports.

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followed and the test data collection requirements to satisfy the test objectives.

3.5 Safety. Develop adequate safety measures for test personnel and equipment. Take appropriate steps (safety check list, posters, etc.) to insure that the safety measures are observed throughout the test (see TOP 7-3-506, Safety (Aviation Materiel)),¹¹ and acquire any test safety releases as required in accordance with TECOM Regulation 385-6, Safety: Verification of Safety of Materiel During Testing.¹²

3.6 Environmental Impact. Determine if there are any environmental considerations. If environmental hazards exist, develop procedures or outline precautions to be observed to protect the environment.

3.7 Human Factors Engineering. Make plans to assess the degree to which human factors engineering regarding operator safety performance and effectiveness has been designed into the developmental defogging/defrosting equipment when operated and maintained by qualified personnel in the operational environment. See TOP 1-2-610,¹³ dated 20 December 1977.

3.8 Security. Security safeguards for the United States Government and for the security of the developmental test materiel must be considered early in the test planning stage. The following steps must be taken:

- a. Consult the primary test agency security representative for security guidance. Coordinate with security personnel of other test support agencies and industry as appropriate.
- b. Take appropriate security measures throughout the test to safeguard intra-industry proprietary and classified material and to safeguard the security of government property.
- c. See TOP 7-3-530, Vulnerability and Security (Aviation Materiel).¹⁴

11. TOP 7-3-506, Safety (Aviation Materiel).

12. TECOM Reg 385-6, Safety: Verification of Safety of Materiel During Testing.

13. TOP 1-2-610, Human Factors Engineering.

14. TOP 7-3-530, Vulnerability and Security (Aviation Materiel).

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4. TEST CONTROLS. The defogger/defroster system test will be conducted and test data will be recorded in strict compliance with the test design plan. If specific directions are not available, the following guidelines will prevail:

- a. Measurement units will be observed and recorded in the universal metric and English system.
- b. Numerical observations will be rounded up to the nearest hundredth.
- c. Time will be recorded to the nearest hundredth of an hour.
- d. Physical characteristics will be accomplished and recorded in compliance with TOP 7-3-500.¹⁵
- e. Instrumentation and equipment will be properly calibrated and have a current calibration certificate.
- f. All tests will be conducted and data collected in compliance with prescribed and/or standard procedures and when deviations are required, justification will be documented.
- g. All data will be recorded and processed in a timely fashion.
- h. Only properly trained and qualified personnel will participate in the conduct of the test.
- i. The defogger/defroster system test will be conducted only in a test environment representative of the operational environment intended for the materiel use.
- j. Each test run will be conducted under controlled and documented conditions, such that the test results could be duplicated or compared.
- k. The detailed test plan will be followed, deviations from same will be documented.

15. TOP 7-3-500, Physical Characteristics (Aviation Materiel).

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5. PERFORMANCE TEST. The conduct of the development test shall be performed in compliance with the test design plan reflected through the detailed test plan. However, if specific guidance is not available in the test design plan, the test plan will reflect the following criteria and methodology to conduct the developmental performance test of the defogger/defroster system. In the interest of good testing practice and cost effectiveness, compatible materiel subtests shall be conducted concurrently whenever possible so that possible interrelated problems can be identified and minimum data collection time can be effected. This section covers the procedures for accomplishing the performance subtest presented in paragraph 3.2 d.

5.1 Method. The operational performance of the defogger/defroster equipment shall be evaluated during ground operations, with and without engines running, and during transient and steady state flight operations with aircraft flying at different altitudes and speeds within the limitations of the aircraft. Evaluate the equipment under each climatic and atmospheric condition representative of the operational environment the designated aircraft is expected to see within its operational theater. The resultant evaluations shall be compared with the requirements established by the MN or other approved documents.

a. Ground Operation - Engines Off.

(1) Exercise all manually operated controls to determine ease of movement and resultant equipment responses.

(2) Using ground power source, turn on defogger/defroster equipment, if applicable, and determine its ability to prevent formation of fog or frost on transparent areas, or time required to eliminate it if already present.

b. Ground Operation - Engines On.

Adjust environmental control unit for optimum operation, then turn on defogger/defroster equipment and evaluate its capability to prevent formation of fog or frost on transparent areas or time required to eliminate it if already present.

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c. Flight Operation.

Insure that the environmental control unit is adjusted for optimum operation, with the defogger/defroster equipment operating and evaluate its capability to prevent formation of fog or frost on transparent areas or time required to eliminate it if formation occurs during flight. Perform this operation for transient flight (climb, dive, landing, acceleration) and steady state flight including minimum and maximum speeds at low and high altitudes.

5.2 Data Required. Complete the data collection form presented in Appendix B. Record the exact operational conditions and operational procedures for each operational mode as appropriate.

a. Comment on the ease of operation and equipment response to any manually operated controls.

b. Comment on the capability of the defogger/defroster equipment to prevent formation of fog or frost on transparent surfaces or to eliminate it when present.

c. Record the following:

- (1) Temperature - inside aircraft, outside aircraft.
- (2) Humidity.
- (3) Location of formation on aircraft transparencies.
- (4) Amount of fog or frost formation (heavy; medium; light).
- (5) Time required to clear transparencies.
- (6) Altitude.
- (7) Airspeed.
- (8) Aircraft flight mode.

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(9) Wind velocity and direction relative to the aircraft transparency under consideration, if applicable.

6. DATA REDUCTION AND PRESENTATION.

a. The total data gathered in support of the subtest objective presented in paragraph 3.2 (a - i) will be analyzed to determine how well the defogger/defroster equipment under test meets the test criteria and test objective established in the detailed test plan. In the instance of a total or partial failure of the developmental system, explain the overall implications to the defogger/defroster system itself and to the operational mission objective.

b. Summarize the test results and present any instances where the test equipment fails to meet the test criteria or design objectives.

c. Provide, when possible, recommendations for solutions to any problems encountered.

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APPENDIX A

CHECKLIST

Aircraft Defogging and Defrosting
(Transparent Areas)

- | | YES | NO |
|---|-----|----|
| 1. Has developmental testing been completed in accordance with the appropriate TOP presented for each subtest presented in paragraph 3.2 (a - i)? | | |
| 2. Were all test objectives presented in paragraph 3.2 (a - i) addressed and if not accomplished, adequately explained? | | |
| 3. Were the test facilities and other accommodations and support equipment sufficient to accomplish the test? | | |
| 4. Were the test results compromised in any way due to insufficient test preparation? | | |
| 5. Were the test results compromised in any way due to test control procedures? | | |
| 6. Were the test results compromised in any way due to performance test procedures? | | |
| 7. Were the test results compromised in any way due to data gathering, reduction or presentation techniques? | | |
| 8. Have all data collected been reviewed for correctness and completeness? | | |
| 9. Have performance data been collected, recorded and presented in accordance with this TOP 7-3-522? | | |

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APPENDIX B

DATA COLLECTION FORM

Aircraft Detoggling and Defrosting
(Transparent Areas)

1. Defogger/Defroster equipment identification _____
2. Aircraft type - configuration _____
3. Climatic zone represented _____
4. Atmospheric/Meteorology data
 - a. Temperature inside aircraft _____
 - b. Temperature outside aircraft _____
 - c. Humidity _____
 - d. Wind condition relative to transparency under consideration
Velocity Direction
K 0-359 Degrees

- e. Altitude (Ref. sea level) _____
- f. Atmospheric moisture composition _____
5. Aircraft flight mode _____
6. Aircraft indicated airspeed _____
7. Type test moisture/composition fog or frost _____

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8. Location of transparency on/in aircraft;
indicate test moisture location relative to
transparency (description/photograph) _____

9. Amount of moisture formation - heavy,
medium, light (photograph) _____
10. Time required to clear transparency _____

11. DISCUSSION:

- a. Comment on the ease of equipment operation and equipment response
to any manually operated controls.

- b. Comment on the capability of the defogger/defroster equipment to
prevent formation of fog or frost on transparent surfaces.
